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Yuto Hirayama

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The Temporal Anteriority/Posteriority Parameter in Inference

Abstract

This paper argues that the semantics of the English epistemic modal *should* and Japanese indirect evidential *yooda* involves temporal requirements on the relation between the temporal denotation of their prejacent and the time in which the speaker acquires the evidence for the utterance (EAT, following the terminology in Lee (2013) and Smirnova (2013)). The English *should* requires EAT to come earlier than the initial moment of the prejacent's temporal denotation, while the Japanese *yooda* encodes the opposite temporal relation between these two components. I further propose that the differences between the two with regard to these temporal components can be parameterized with a micro parameter. The findings of this paper have two implications. The first is that there are evidentials that encode temporality but are not involved in the temporal inflection on the prejacent's verb. The other implication is that the temporal relation between EAT and the prejacent's temporal denotation may be a universal semantic building block (von Stechow and Matthewson 2008).

The Temporal Anteriority/Posteriority Parameter in Inferenceals

Yuto Hirayama*

1 Introduction

This paper argues that the semantics of the English epistemic modal *should* and Japanese indirect evidential *yooda* involves temporal requirements. I further propose that the differences between the two with regard to these temporal components can be parameterized with a micro parameter. Throughout this paper, I use the term *inferenceals* to cover inferential expressions, including epistemic modals and evidentials. The temporal requirements I address concerns the relationship between the temporal denotation of the prejacent and the time in which the speaker acquires the evidence for the utterance, which I call Evidence Acquisition Time, EAT, following the terminology used by Lee (2013) and Smirnova (2013), among others. My argument is informally as follows: Let p be the prejacent and $\text{EARLIEST}(p)$ be the initial time that p is true. Then, *should* is only felicitous if $\text{EAT} < \text{EARLIEST}(p)$ (i.e., EAT temporally precedes $\text{EARLIEST}(p)$), while *yooda* is only felicitous if the reverse relationship is obtained; that is, if $\text{EARLIEST}(p) \leq \text{EAT}$.

This paper focuses on the epistemic use of *should*. As a convention, I accordingly use the semantic anomaly mark # on *should*-sentences in this paper to mean that *should* does not have the epistemic reading in those cases; # does not indicate that *should* is infelicitous in either the epistemic or deontic readings (# on sentences with other inferenceals entails the usual interpretation). I also use expressions such as “*should* is infelicitous/deviant/unacceptable...”; these mean that the epistemic interpretation of *should* cannot be obtained.

The rest of this paper is structured as follows. Section 2 discusses observations indicating that *should* and *yooda* hardwire their own temporal requirements. It also argues that the causal analysis based on Davis and Hara (2014) cannot explain all data and that the temporal requirements are needed independently. Section 3 formulates the idea presented in Section 2. Section 4 proposes parameterization over the semantic difference between the two inferenceals, and discusses how other inferenceals (i.e. the German epistemic modals *sollte* and *müsste* and Japanese reportative evidential *sooda*) share the relevant parameter. Finally, Section 5 briefly describes the implications of this paper on the current evidential literature and the universality of the semantic categories.

2 The need for temporal requirements

This section presents that *should* and *yooda* hardwire $\text{EAT} < \text{EARLIEST}(p)$ and $\text{EARLIEST}(p) \leq \text{EAT}$, respectively. Section 2.1 introduces basic observations. Section 2.2 addresses whether the causal approach inspired by Davis and Hara (2014) is sufficient for capturing all data, and argues that the temporal requirements are needed independently from the causal ones.

2.1 Basic observations

We begin with the following examples:

- (1) (P visits M in the hospital. P sees through the window of the hospital room that the doctors look worried. P says:)
 - a. #She should be very sick. (Matthewson and Truckenbrodt (2018:299))
 - b. Kanojo-wa totemo taiyoo-ga warui yooda.
she-TOP very health-NOM bad yooda
'It seems that she is very sick.'

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In (1), EAT is the time P sees the doctor look worried. The prejacent is *She is very sick* and EARLIEST(*p*) is the moment she got very sick. Given that the doctors begin to worry about the patient's health after they learn that she is in bad condition, EARLIEST(*p*) is prior to EAT.

The two inferentials show opposite acceptability in the following example:

- (2) (P poisons M's food and leaves. Later, P says:)
- a. She should be very sick now. (Matthewson and Truckenbrodt (2018:299))
 - b. #Kanojo-wa ima totemo taiyoo-ga warui yooda.
 she-TOP now very health-NOM bad yooda
 'It seems that she is very sick now.'

Here, EAT = the time P poisons M's food, and EARLIEST(*p*) = the moment she became very sick. Of course, the act of poisoning the food precedes the instance in which the person who ingests it becomes sick. Therefore, EAT < EARLIEST(*p*) in this context. The acceptability of the two inferentials in (1) and (2) suggests that *should* and *yooda* lexically encode EAT < EARLIEST(*p*) and EARLIEST(*p*) ≤ EAT, respectively.

2.2 Causation is not the whole story

One may question the necessity of the temporal requirement. Davis and Hara (2014) argue that *yooda* imposes a causal requirement in which the event in its prejacent causes the event described in the proposition serving as evidence (henceforth, the evidence proposition). As we will see below, this requirement explains the contrast between (1b) and (2b).¹ The *should*-data (1a) and (2a) are also captured if we posit the converse direction of causation for *should*, that is, the requirement that the prejacent of *should* must be caused by the evidence proposition. Are the temporal requirements then necessary? This subsection argues that the causal analyses are not sufficient for explaining the distribution of inferentials. As such, the temporal requirements must be maintained independently from the causal one.

First, (in)felicity of the two inferentials can be accounted for by positing Davis and Hara's causal requirement for *yooda* and the opposite requirement for *should*. In (1), the prejacent (*she is very sick*) causes the doctors to look worried. The context is thus compatible with the causal requirement of *yooda*, but not with that of *should*. In (2), the evidence proposition (*the speaker P poisoned M's food*) conversely causes the prejacent (*she is very sick*). As such, *should* is felicitous while *yooda* is not. Thus, the causal requirements may appear sufficient for capturing the distribution of the two inferentials.

However, *should* and *yooda* are infelicitous if their relevant temporal requirements (EAT < EARLIEST(*p*) for *should* and EARLIEST(*p*) ≤ EAT for *yooda*) are violated. This is true even when their causal requirements are satisfied. Specifically, *should* is infelicitous in (3):

- (3) (If John is presenting at a conference, he always practices in his hotel-room bathroom in the morning before his talk. You had no idea John was presenting at this conference, but you show up and see him presenting. Someone asks you where John was this morning. You say:)
- #John should have been in his hotel-room bathroom practicing for his presentation.

The prejacent is *John was in his hotel-room bathroom practicing for his presentation*, and the evidence proposition is *John is now presenting*. Therefore, *should*'s causal requirement that the evidence proposition cause the prejacent is satisfied given that John's upcoming presentation causes him to be in his bathroom. However, its temporal requirement is not satisfied because it is clear that EAT (the time when the speaker sees John presenting) does not precede EARLIEST(*p*) (the moment John entered his bathroom). The infelicity of (3) indicates the presence of the temporal requirement. This is further supported by the felicity of the following example:

¹Relatedly, Takubo (2009) and Krawczyk (2012) argue that the prejacent of evidentials must be the explanations for the evidence.

- (4) (If John is presenting at a conference, he always practices in his hotel-room bathroom in the morning before his talk. Yesterday, you saw on the website of the conference that he would be presenting today. Today, in the morning, someone asks you where John is. You say:)
John should be in his hotel-room bathroom practicing for his presentation.

The context satisfies the causal requirement as in (3): John's presentation causes him to be in his bathroom. In (4), however, EAT is the time when the speaker saw the conference website and $\text{EARLIEST}(p)$ is the moment John entered his bathroom, so $\text{EAT} < \text{EARLIEST}(p)$, satisfying *should*'s temporal requirement. The contrast between (3) and (4) empirically underpins the necessity of the temporal requirement.

The same argument is also valid for *yooda*. Consider (5):

- (5) (John comes to university in a formal suit only if he is going to attend a party that night. You saw John wearing a formal suit at the university at lunchtime today. Tonight, John's friend calls you and asks where he is. You say:)
#John-wa ima paatii-ni syussekesi-tei-ru yooda.
John-TOP now party-at attend-PROG-PRES yooda
'It seems that John is at a party.'

In (5), the prejacent and evidence propositions are *John is at a party* and *John is wearing a formal suit*, respectively. Davis and Hara's (2014) causal requirement is satisfied because John's attendance causes him to wear the suit. However, (5) is unacceptable. In this example, EAT = the time the speaker saw John wearing a formal suit, while $\text{EARLIEST}(p)$ = the moment John arrived at a party, so $\text{EAT} < \text{EARLIEST}(p)$, thereby violating *yooda*'s temporal requirement. Note that *yooda* becomes felicitous if the speaker discusses John's future attendance:

- (6) (John comes to university in a formal suit only if he is going to attend a party that night. Today, you see John wearing a formal suit at the university at lunchtime. Just at that moment, John's friend calls you and asks where John will be tonight. You say:)
John-wa kyoo paatii-ni syussekesi-ru yooda.
John-TOP today party-to attend-PRES yooda
'It seems that John will attend a party.'

As we will see below, assuming the modal analysis of the future tense (Enç (1996), among others), the prejacent of (6) (*John will attend a party today*) becomes true when John's future attendance is determined (e.g., when John decides to attend). Therefore, $\text{EARLIEST}(p)$ precedes EAT, that is, the moment the speaker sees John wearing a formal suit, because his attendance must have been determined when he put on the suit, let alone when the speaker sees him wearing it. That is, (6) is compatible with $\text{EARLIEST}(p) \leq \text{EAT}$. If *yooda* did not hardwire such a temporal constraint, then the contrast between (5) and (6) would not arise.

One may argue against the current claim that the causal requirements cannot capture the oddity of (3) and (5), by saying that they are infelicitous because the effect of the causation temporally precedes its cause in those examples. Traditionally, one of the necessary conditions for causation is that the effect must not precede its cause (cf. Menzies (2017)). If *should* and *yooda* encode such a traditional causation, then it can be said that they are infelicitous when the cause-preceding requirement is violated. In fact, (3) and (5) violate this requirement; the effects (i.e., John being in his bathroom practicing for his presentation in (3) and John wearing a formal suit in (5)) precede the causes (i.e., John having a presentation in (3) and John being at a party in (5)).

However, if causation involved in the semantics of *should* and *yooda* imposes the cause-preceding requirement, then it will also rule out (4) and (6). This is because causation is a relationship between *events*; the causes and effects in these examples are the same events as in their counterpart examples. Specifically, in both (3) and (4), the cause is the event in which John has a presentation, while the effect is that John is practicing for it in his bathroom.² In both (5) and (6), the cause is the

²The cause in (4) is not the event in which the speaker sees the website: The speaker seeing the website cannot cause John to be in his bathroom.

John-attending-party event, while the effect is the John-wearing-suit event. Therefore, if (3) and (5) are infelicitous due to violation of the cause-preceding requirement, (4) and (6) should be ruled out for the same reason. The felicity of the latter examples indicates that *should* and *yooda* allow the backward causation in which the cause comes later than the effect, and (3) and (5) sound odd due to violation of the temporal requirements $EAT < EARLIEST(p)$ and $EARLIEST(p) \leq EAT$.

Furthermore, if the causation involved in the two inferentials accompanies the cause-preceding requirement, then it should form the temporal relation between the prejacant event and the event of the evidence proposition (which I call the evidence event) rather than the relation between the prejacant and EAT. Specifically, *should* and *yooda* ought to require $EARLIEST(\tau(e_{ev})) \leq EARLIEST(p)$ and $EARLIEST(p) \leq EARLIEST(\tau(e_{ev}))$, respectively, where $\tau(e_{ev})$ is the runtime of the evidence event. Then, *should* is predicted to be felicitous, while *yooda* is to be infelicitous, if $\tau(e_{ev}) \leq EARLIEST(p) \leq EAT$. However, these predictions are not borne out.

- (7) a. (You see John's facebook profile and learn that yesterday was John's birthday. You didn't know this. John is a very sociable person and has many friends that would come to his birthday party if he calls on them to come. You say:)
 #John should have had a birthday party.
 b. (John comes to university with a tennis racket bag only when he plays tennis after lunchtime. Today, in the evening, you see John carrying a racket bag. You say:)
 John-wa kyoo tennis-o si-ta yooda.
 John-TOP today tennis-ACC do-PAST yooda
 'It seems that John played tennis today.'

In (7a), the evidence event (it being John's birthday) causes him to have a birthday party, but the initial moment of its runtime does not follow $EARLIEST(p)$ (i.e., when John began his birthday party). Therefore, the evidence causes the prejacant and the cause-preceding requirement is fulfilled. However, the temporal requirement $EAT < EARLIEST(p)$ is violated because EAT is the time when the speaker checks the calendar. The badness of (7a) underpins the necessity of my proposed temporal requirement. In (7b), on the other hand, the earliest moment of the evidence event is when John came to university with his racket bag. Such a moment precedes the causing event, i.e., *John playing tennis*, meaning that the cause-preceding requirement is violated as in (5). However, (7b) is felicitous (unlike (5)) because $EARLIEST(p) \leq EAT$ is satisfied (EAT is when the speaker sees John carrying his racket bag in the evening). If the cause-preceding requirement were involved in the two inferentials, then the two examples in (7) would show the opposite acceptabilities.

Although the temporal requirements explain all data presented so far, note that this does not mean that we can do without the causal requirements. Indeed, the causal requirement of *yooda* as proposed by Davis and Hara (2014) accounts for the contrast found in the following examples.

- (8) a. (Seeing a wet street, you say:)
 Ame-ga fut-ta yooda.
 rain-NOM fall-PAST yooda
 'It seems that it rained.'
 b. (Seeing falling raindrops from the window, you say:)
 #Michi-ga nureteiru yooda.
 street-NOM wet yooda
 'It seems that streets are wet.'

In (8a), the prejacant (*it rained*) causes the evidence proposition (*a street is wet*), while such a causation in (8b) does not hold (wet streets do not cause raindrops to fall). As such, Davis and Hara's causal requirement that *yooda*'s prejacant must be the cause of the evidence proposition captures this contrast. Our temporal requirement does not exclude (8b); EAT, which is at the same time or just before UT, clearly comes later than $EARLIEST(p)$ (i.e., the moment streets got wet). We must therefore posit the causal requirement independently of the temporal one in order to capture the correct distribution of *yooda*.

Likewise, we should maintain the causal requirement on *should* in which its prejacant must be caused by the evidence proposition. Consider the following:

- (9) (Looking at someone who looks green in the face)

#He should vomit soon.

(Matthewson (2015))

EAT is at the same time or just before UT, while $\text{EARLIEST}(p)$ is the moment he vomits. Therefore, the temporal requirement $\text{EAT} < \text{EARLIEST}(p)$ is satisfied; nevertheless, (9) is odd. The causal requirement accounts for the deviance: the evidence proposition *someone looks green in the face* does not cause the prejacent *he vomits soon*. If the evidence event successfully causes the prejacent event, *should* is felicitous with the same temporal relation, as follows:

- (10) (The speaker has just inhaled some sneezing powder)

I should sneeze.

(Matthewson (2015): cited from Yalcin (2016:241-242))

EAT (when the speaker inhaled powder) precedes the moment the speaker sneezes, and the evidence event (the event in which the speaker inhaled powder) causes the sneezing event. The contrast between (9) and (10) indicates that the causal requirement is also necessary in empirical terms.

3 Formal implementation

This section discusses formalization of the temporal requirements for *should* and *yooda*. I assume the referential tense, following Partee (1973) and Kratzer (1998), among others:³

- (11) a. A proposition without tense: $\llbracket p \rrbracket^g = \lambda t_i. \lambda w_s. p(t)(w) = 1$.
 b. $\llbracket \text{present} \rrbracket^g$ is defined only if there is a contextually salient time t_1 such that $\text{UT} \subseteq t_1$.
 If defined, $\llbracket \text{present} \rrbracket^g = t_1$.
 c. $\llbracket \text{past} \rrbracket^g$ is defined only if there is a contextually salient time t_1 such that $t_1 < \text{UT}$.
 If defined, $\llbracket \text{past} \rrbracket^g = t_1$.

The referential tense theory says that tenses are pronouns that carry a presupposition which specifies the temporal relation between them and the time of utterance.

I formulate the EARLIEST operator as in (12), following Beaver and Condoravdi (2003):

- (12) a. $\text{EARLIEST}_w = \lambda p_{\langle i, st \rangle} \cdot$ the unique m such that
 $\llbracket p \rrbracket^g(\{m\})(w') \wedge \forall t' [\llbracket p \rrbracket^g(t')(w') \rightarrow m \leq t']$ for a world w' maximally similar to w .
 b. $m \leq t$ iff $\forall m' [m' \in t \rightarrow m \leq m']$.

The EARLIEST operator takes a proposition p of type $\langle i, st \rangle$ and picks up the moment that precedes all other intervals making p true. Note that m is required to make p true in some world that is maximally similar to w rather than in w . If m makes p true in w (instantiates p in Beaver and Condoravdi's (2003) terminology), then the EARLIEST operator will be veridical. Given that p corresponds to the prejacent of *should* and *yooda*, the veridicality of the operator results in the veridicality of the two inferentials, which is undesirable.⁴

As the reader may have already noticed, a tensed proposition (as is) is incompatible with the EARLIEST operator in terms of type. In this framework, tensed propositions are of type $\langle s, t \rangle$ while the argument of the EARLIEST operator must be of type $\langle i, st \rangle$. We must therefore posit an abstraction rule that converts $\langle s, t \rangle$ elements to $\langle i, st \rangle$ elements. Following Sharvit (2014), I assume the rule (13) and (14) is how it works:

³Sharvit (2014) argues that the Japanese past tense is existential, while the English past tense is referential. In (11), I do not intend to argue against this claim. Rather, my idea can be implemented even with the existential past tense (see Hirayama (to appear) for details). I adopt the referential view simply because I cannot show how my idea is implemented with existential tenses in addition to the implementation with referential tenses for the sake of space.

⁴Although inferentials are basically considered non-veridical, several previous studies have argued that their target inferentials are veridical (von Stechow and Gillies (2010) for the English epistemic modal *must*, and Sauerland and Schenner (2007), Koev (2011) for Bulgarian indirect evidential *-l-*).

- (13) $\llbracket p \rrbracket^g$ can be shifted to $[\lambda x. \llbracket p \rrbracket^{g[n \rightarrow x]}]$, which is defined only if the presupposition of $\llbracket p \rrbracket^{g[n \rightarrow x]}$ is satisfied, where x is an arbitrary variable.
- (14) a. $\llbracket \textit{She is very sick} \rrbracket^g = \lambda w. \text{she is very sick at } t_1 \text{ in } w$ (defined only if $UT \subseteq t_1$).
 b. ((13) applied)
 $\lambda t. \llbracket \textit{She is very sick} \rrbracket^{g[1 \rightarrow t]}$, defined only if the presupposition of $\llbracket \textit{She is very sick} \rrbracket^{g[1 \rightarrow t]}$ is satisfied.
 c. $= \lambda t. \lambda w. \text{she is very sick at } t \text{ in } w$, defined only if $UT \subseteq t$.

As shown above, the abstraction rule (13) converts the type of a tensed proposition to $\langle i, st \rangle$, with which a type mismatch does not occur when the EARLIEST operator is applied to that proposition.

With these assumptions, I propose the following definedness conditions for *should* and *yooda*.⁵

- (15) Let q be the contextually salient proposition serving as evidence:
- a. $\llbracket \textit{should} \rrbracket^g(p)(w)(t)$ is defined only if
 $\exists t' [\text{the speaker learns } q \text{ at } t' \wedge t' \leq t \wedge t' < \text{EARLIEST}_w(p)]$.
- b. $\llbracket \textit{yooda} \rrbracket^g(p)(w)(t)$ is defined only if
 $\exists t' [\text{the speaker learns } q \text{ at } t' \wedge t' \leq t \wedge \text{EARLIEST}_w(p) \leq t']$.

In the above formulation, t' is the time when the speaker learns the evidence proposition, that is, EAT. Given that evidence acquisition comes at least as early as the utterance based on the evidence, we need the second conjunct $t' \leq t$ (as argued by Smirnova (2013)). *Should* requires that t' precede $\text{EARLIEST}(p)$, while *yooda* requires the reverse ordering: $\text{EARLIEST}(p) \leq t'$.

As I mentioned above, *yooda*'s temporal requirement $\text{EARLIEST}(p) \leq t'$ may seem inconsistent with cases in which the prejacent describes a future event such as (6). This is because its runtime is inevitably located later than EAT. Koev (2011) argues that the Bulgarian indirect evidential *-l-* is only felicitous if the runtime of the prejacent event precedes EAT, and faces the same problem. To circumvent this, he assumes that *-l-* will require EAT to temporally follow some salient stages of the preparatory process of the prejacent event instead of its runtime, when the prejacent's tense is non-past. However, as Smirnova (2013) points out, the ontological status of such a preparatory process is unclear, and there is no independent motivation for such an assumption.

However, my analysis accommodates cases in which the prejacent involves a future event, with the modal analysis of future tenses (Enç (1996) and Bochnak (2019), among others):

- (16) $\llbracket \textit{Future } p \rrbracket^g = \lambda t. \lambda w. \forall w' [w' \in \cap \text{MB}(t)(w) \rightarrow \exists t' [t < t' \wedge p(t')(w')]]$.

This is a Kratzer-style modal analysis for future tenses. $\text{MB}(t)(w)$ represents the circumstantial modal base consisting of the relevant facts at t in w (Abusch (2012)).⁶ *Future-p* becomes true when the facts entail that p will be true in the future. With this, the prejacent of (6) denotes the following:

- (17) $\llbracket \textit{John will be at a party} \rrbracket^g = \lambda t. \lambda w. \forall w' [w' \in \cap \text{MB}(t)(w) \rightarrow \exists t' [t < t' \wedge \text{John is at a party at } t' \text{ in } w']]$.

This becomes true when the facts entail that John will be at a party in the future. In other words, it becomes true when John's future attendance is determined (e.g., when John decides to attend the party). Therefore, the temporal denotation of (17) (i.e., the set of intervals t such that (17) is true at t) is the set of intervals at which John's future attendance is determined. Thus, $\text{EARLIEST}(p)$ is the exact moment when John's future attendance is determined. Such a moment clearly precedes EAT in (6) (the moment the speaker sees him wearing a formal suit), because John's future attendance must have been determined when the speaker witnesses him wearing a suit. The relevant temporalities are depicted in Figure 1.

Note that one of the differences between my account and Koev's (2011) is that my account does not rely on the runtime of events. Rather it relies on the temporal denotation of the prejacent. $\text{EARLIEST}(p)$ are not required to correspond to the initial moment of the runtime of the prejacent

⁵I do not commit to what assertive content the two inferentials have.

⁶(16) is somewhat simplified because it makes no reference to the ordering source. I redact these complications because a reference to the modal base is enough for my account to work.

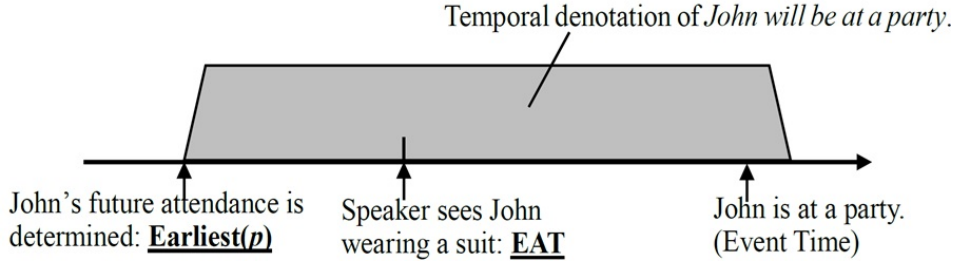


Figure 1: The relevant temporalities in (6)

event; in the case of future-tensed sentences, the event time is located in the future. It can never come as early as EAT, while the leftmost point of the temporal denotation can. Thus we are not forced to posit additional assumptions onto the ontology.

4 Parameterization and other inferentials

We have so far seen that the two inferentials *should* and *yooda* hardwire their own temporal requirements: $EAT < EARLIEST(p)$ for *should* and $EARLIEST(p) \leq EAT$ for *yooda*. This difference can be parameterized in terms of whether EAT is anterior/posterior to $EARLIEST(p)$, as in Table 1, where [EAT-anterior] means that EAT comes before $EARLIEST(p)$ and [EAT-posterior] means the opposite relationship.

<i>should</i>	<i>yooda</i>
[EAT-anterior]	[EAT-posterior]

Table 1: Parametric variation in the semantics of the two inferentials

If the difference between the two inferentials is the result of a semantic parameter [EAT-anterior/posterior], then it is highly conceivable that other inferential expressions share the same parameter settings, and those inferentials are subject to the same definedness conditions as (15) (in other words, the conditions in (15) are not idiosyncratic to *should* and *yooda*). This conjecture is correct: the German epistemic modals *sollte* and *müsste* are [EAT-anterior] while the Japanese reportative evidential *sooda* is [EAT-posterior].⁷ First, the German *sollte* and *müsste* show the same distribution as *should* as far as the contexts in (1) and (2) are concerned:

- (18) a. (P visits M in the hospital. P sees through the window of the hospital room that the doctors look worried. P says:)
 #Sie sollte/müsste sehr krank sein.
 she sollte/müsste very sick be
 ‘She should be very sick.’ (Matthewson and Truckenbrodt (2018:298-299))

⁷It may seem strange that I treat *sooda* as an inferential, since there is no agreement about whether the speaker makes inference when using reportatives, although previous studies such as Matthewson et al. (2007) argue that some reportative evidentials are epistemic modals, a typical instance of inferentials. Given the following data, I claim that the use of *sooda* involves some inference:

- (i) (A told you that it is not raining. Then B asks you whether she needs to take an umbrella when she leave. You answer:)
 Kasa-wa hituyoo-nai sooda.
 umbrella-TOP necessary-NEG sooda
 ‘I hear that you don’t need an umbrella.’

In (i), the reportative evidence (i.e., A’s report about raining) says nothing about whether B needs to take an umbrella. However, the speaker uses A’s report to infer that B needs to do so.

- b. (P poisons M's food and leaves. Later P says:)
 Sie sollte/müsste sehr krank sein.
 she sollte/müsste very sick be
 'She should be very sick.' (Matthewson and Truckenbrodt (2018:298-299))

As I mentioned in Section 2.1., $\text{EARLIEST}(p) < \text{EAT}$ in (18a), and $\text{EAT} < \text{EARLIEST}(p)$ in (18b). *Sollte* and *müsste* are only felicitous in (2), just as *should*. This means that they and *should* share the temporal requirement $\text{EAT} < \text{EARLIEST}(p)$ and that they are also [EAT-anterior] as well.

By contrast, the Japanese reportative evidential *sooda* is [EAT-posterior]. It sounds odd when EAT (when the speaker obtains reportative evidence about the prejacent) precedes $\text{EARLIEST}(p)$, while it does not when EAT does not precede $\text{EARLIEST}(p)$:

- (19) a. (At lunchtime, John told you that he was going to attend a party tonight. Tonight, someone asks you what John is doing. You say:)
 #John-wa paatii-ni syussekesi-tei-ru sooda.
 John-TOP party-to attend-PROG-PRES sooda.
 'I hear that John is at a party.'
 b. (John tells you that he is going to attend a party tonight. Just after that, someone asks you what John is going to do tonight. You say:)
 John-wa paatii-ni syusseki-suru sooda.
 John-TOP party-to attend-PRES sooda
 'I hear that John is going to attend a party.'

In (19a), where *sooda* is infelicitous, EAT is when the speaker was told about John's attendance, while $\text{EARLIEST}(p)$ is the moment John arrives at a party. This is because the prejacent in (19a) is the present progressive form. Therefore, $\text{EAT} < \text{EARLIEST}(p)$. In (19b), on the other hand, while EAT is the same time as that in (19b), the prejacent of (19b) is a future proposition with a temporal denotation that contains intervals at which John's future attendance is determined (as I explained in Section 3). Given that one does not tell others that she is going to a party before she decides to do so, $\text{EARLIEST}(p)$ precedes EAT in (19b). In these examples, the (in)felicity of *sooda* in these examples shows that it is [EAT-posterior] just as *yooda*.

We have seen that the German *sollte* and *müsste*, as well as the Japanese *sooda* encode the temporal requirements on the relation between EAT and $\text{EARLIEST}(p)$, in addition to *should* and *yooda*. This supports the claim that the temporal semantic parameter [EAT-anterior/posterior] is not specific to *should* and *yooda*, thus indicating the possibility that such a parameter is ubiquitous among inferential meanings.

5 Implications

The first implication concerns the fact that *yooda* has a different status compared to evidentials that are considered to have temporal contributions in the literature. Just as I observed for *yooda*, several previous studies (Fleck (2007), Chung (2007), Lee (2013), Smirnova (2013), to name a few) observe that evidentials encode a temporal restriction on the relationship between EAT and the prejacent in their target languages. My findings are novel because those temporal evidentials addressed in the literature are all involved in (or fused with) tense-inflections. For example, Smirnova (2013) argues that the Bulgarian indirect evidential *-l-*, which is involved in the verbal inflection, requires its prejacent to be evaluated relative to EAT rather than to UT. Likewise, the Korean evidential *-te*, which interacts with the prejacent's temporal denotation, is one instance of the Korean tense system according to Chung (2007) (Table 3).

However, *yooda* differs from this type of evidentials in that it is not involved in tense-inflection, as follows:

- (20) John-ga ki-ta ga Mary-wa ko-naka-tta yooda.
 John-NOM come-PAST but Mary-TOP come-NEG-PAST yooda
 'It seems that John came but Mary did not come'

	Indicative form	Evidential form
Present	<i>piše-∅</i> write.IPFV-3SG.PRES	<i>piše-l-a</i> write.IMPF _{PRES} -EVID-FEM
Past	<i>pisa-∅</i> write.IPFV-3SG.PAST	<i>pisa-l-a</i> write.IMPF _{PAST} -EVID-FEM

Table 2: The inflectional table for *piša* ‘write’ (Adapted from Smirnova (2013:483))

	Simple tense	Evidential tense
Present	<i>-nun</i> or <i>∅</i>	<i>-ney</i>
Past	<i>-essess</i>	<i>-te</i>

Table 3: The Korean tense system (Adapted from Chung (2007:189))

In (20), *yooda* scopes over the two tensed conjuncts *John came* and *Mary did not come*. If *yooda* were part of the tense-inflection, then it should also be attached to the tense of the first conjunct. This means that the presence of the temporal contributions is not restricted to evidentials that come with tense, thus raising the possibility that temporal aspects of meaning are more prevalent than currently assumed in the evidential literature (Matthewson and Hirayama (2019) report that English indirect evidentials *apparently* and *seem* and the St’át’imcets indirect evidential *-an* encode the same temporal restriction as *yooda*).

The second implication is that the observations on *should*, *yooda*, and other inferentials in this paper support von Fintel and Matthewson (2008), who hypothesizes that semantic categories are composed of smaller building blocks. According to von Fintel and Matthewson, the class of *accomplishment verb* cannot be maintained universally, because “at least some Salish languages possess a class of verbs which correspond in their lexical content to English accomplishments, but which do not entail culmination of the event in the perfective aspect” (von Fintel and Matthewson (2008:154)). They instead hypothesize the existence of smaller universal building blocks and that the event structure of a verb is composed of these. This involves choosing which building block to encode and how. For example, according to Travis (2005), Malagasy accomplishments (unlike English ones) do not entail the culmination of the described event. Rather, it is the result of implicature. This implies that whether or not the described event is culminated is one of the universal building blocks for accomplishments, and Malagasy accomplishments (not English ones) encode it as implicature. This idea can be extended to the inferential domain. This paper had argued that some inferentials encode temporal contributions that are independent from their inferential component (i.e., the one specifying the type of reasoning or inference involved), and the evidence-specifications (e.g., direct, indirect, and reportative) in the case of evidentials. This is compatible with the view that the temporal relationship represented between EAT and the prejacent’s temporal denotation is a potential building block. This view is especially motivated by the fact that *yooda* and *sooda* both encode $\text{EARLIEST}(p) \leq \text{EAT}$, although they have different evidence-type specifications (*yooda* is indirect, while *sooda* is reportative). In other words, the presence of the temporal contribution cross-cuts other aspects of evidential meanings. In addition, note that Matthewson and Hirayama (2019) observe that St’át’imcets and Gitksan reportative evidentials do not pose temporal requirements. Some reportatives (e.g., *sooda*) make temporal contributions while others (e.g., St’át’imcets and Gitksan ones) do not have such components. This corroborates the current conjecture that whether and how the temporal requirement is encoded is a universal building block that exists independently of other inferential meaning aspects such as evidence-type specification.

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Graduate school of Letters / Research Fellow

Osaka University / The Japan Society for Promotion of Science (JSPS)

1-5, Machikaneyama-cho Toyonaka, Osaka, Japan 560-8532

yuto.hirayama.111@gmail.com